Materials and Methods: A MC treatment verification solution was implemented on CloudMC, a cloud-based platform presented in a previous work. CloudMC runs on Windows Azure cloud platform and it had been developed following three basic principles: multi-application, elasticity and accessibility. It was first designed to parallelize simple MC simulations in as many virtual machines as the user selected. New features were now added to convert RT plan information into text MC input files and to merge the simulation output files into a DICOM format dose file that can be compared to the one obtained from the planning system. It was also necessary to develop a method to distribute the different treatment beams calculations among the different virtual machines. The MC programs used to perform the implementation study were BEAMnrc and DOSxyz, both based on the EGSnrc code. CloudMC is independent of the MC code used, i.e. the user may use any program based on any other MC code provided they fulfill some basic requirements.
Several tests were carried out to study the times involved in the different parts of the process (virtual machines start-up, file transfer between machines and the storage system, map-reduce methods, etc.) and the usage costs of the cloud computing resources.
Results: A complete prostate treatment (25 segments distributed in 7 incidences) was simulated using 1.2E9 primary histories from a 20GB IAEA phase space file. The calculation grid was 2x2x5 mm^3. The final dose distribution had an statistical uncertainty below 1.5% (k=1) in the PTV volume. The parallelization was done in 190 small-size virtual machines (1 core, 2.2 Ghz, 1.75 GB RAM). The total calculation time was 1h and 30 minutes, from which 1h and 10 min were spent in the MC simulation. The 190 virtual machines cluster is created and eliminated in each simulation. It needs a start up time that depends on the number and size of the machines. In this case, the start up time took 7 minutes. The management of the result files (2.7GB) was carried out in a medium-size machine. The time spent in downloading, merging and uploading the final result files was 3 min. The usage cost of this simulation was 15 €.
Conclusions: The cloud-based application CloudMC has been updated with a new feature that allows performing MC verifications of RT treatments in a fast, cheap and easy way, accessible to any user. The computing power, accessibility and low costs make commercial clouds a suitable solution to bring MC algorithms closer to daily RT treatment calculations.

PO-0868

Neutron peripheral dose estimation: treatment planning system implementation

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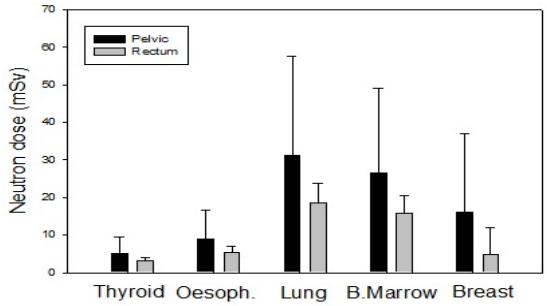
Purpose/Objective: The increasing number of survival radiotherapy patients has generated an emergent concern on second cancers risks, associated to peripheral doses. Out-of field dosimetry of photon and neutron components is still under development. Our group established a methodology for neutron equivalent dose estimation in organs [1]. In addition, an algorithm [2] has been implemented in Philips' Pinnacle TPS for neutron peripheral dose estimation of patients, treated with high energy as a part or the totality of their treatment. The aim of this study was to present, as an example, neutron peripheral doses in pelvic radiotherapy treatments to show the high potential of this tool when choosing the optimal treatment.
Materials and Methods: A self-developed Pinnacle script has been used for neutron peripheral dose estimation in thirteen relevant organs. This study was performed in two centres including 2 different machines (3 Siemens Primus and 1 Siemens Oncor). All of them were previously characterized by following the methodology established in [3].
Pelvic cases that contain high energy (15 or 18 MV) have been considered. As neutron doses strongly depend on MU, once the facility is characterized, dose estimations are done by considering the total number of MU (high energy) and choosing patient gender (male/female) and treatment location (abdomen/H&N). Population taken into account for this study is detailed in the table. Obtained results have been compared to previous values [2] where an important cohort of patients and machines from 50 facilities were evaluated.
Table. *(see text)*

Treatment	Sevilla		Valencia	
	Male	Female	Male	Female
Rectum	26	11	33	23
Cervix	--	10	--	11
Endometrium	--	11	--	14
Bladder	4	2	4	4
Other	3	9	4	10
Total (179)	33	43	41	62

Results: The figure shows mean equivalent doses at different out-of field organs (mSv) in pelvic (see table) and only rectum cases, due to peripheral neutrons from high energy radiotherapy treatments. Some representative organs, located far from the treatment region, have been considered to illustrate neutron peripheral doses.
When comparing all the pelvic values to previous clinical studies [2], considering only the linacs and pathologies presented in this work, the mean deviation obtained for organ doses is 18%, in the range of uncertainties.
Figure.



Conclusions: This new tool would enable the risk-benefit judgements in addition to the rest of the TPS conventional parameters, for the optimal treatment choice. The big error bars shown in the pelvic cases, are due to the fact of considering the mean values of neutron doses obtained for a huge variety of treatments and techniques. They decrease when considering a more homogeneous inter-centres pathology, as the rectum. Treatments that combine low and high energies use a lower number of high energy MU and thus neutron doses are smaller. This fact should be considered in the script for future studies. A good concordance has been observed with previous studies [2] for these cases. Future works should be carried out to analyse other pathologies for a higher number of patients.

Ref.

[1] Phys Med Biol 57 (2012) 6167-6191.
[2] Radiother Oncol 107 (2013) 234–241.
[3] Radiother Oncol 103 (2012) S516–S517.

PO-0869

Stereotactic Body Radiation Therapy (SBRT) planning pre-treatment verification : an Italian multicenter study

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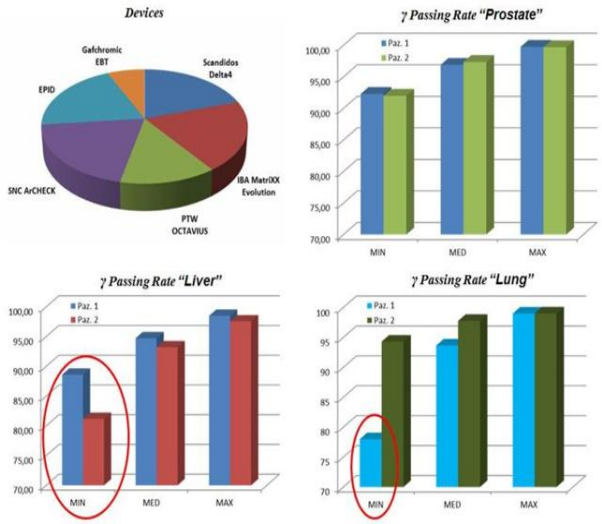
Purpose/Objective: Multicenter studies for pre-treatment planning verifications, sharing methodologies and acceptance criteria, could help in developing common procedures especially for SBRT treatments. The Italian Association of Medical Physics (AIFM) has created a working group dedicated to SBRT and one of the first group project was to perform pre-treatment quality assurance (QA) of common SBRT plans for prostate, liver and lung cancer among different Italian centers.

Materials and Methods: Seventeen centres of the SBRT Italian working group verified, in pre-treatment mode, the SBRT plans according with their home technologies, methodologies and acceptance criteria. A questionnaire including personal Gamma criteria, if dose at isocenter was verified with ion chamber, Gamma Index results and if QA plans were considered deliverable or not. Data are presented as averages over the two patients for each anatomical district.

Results: Sixty plans were analysed. The most common devices available on commerce were used (Gafchromic films, planar and cylindrical array of ion chamber or diode, EPID); the Gamma Analysis approach was local for 12 centres and global for 5 centres; in 75% of cases, DD and DTA criteria were 3%/3mm. For plans related to prostate region, the medium Gamma resulted 97.1% (range 92.1-99.7%); four centres verified dose at isocenter with a maximum deviation of 5.9%; all plans were considered clinically deliverable. For Liver region: 93.7% (range 84.9-98.0%); one centre verified dose at isocenter with a maximum deviation of 2.7%; two plans were considered not acceptable. For Lung region: 95.7% (range 86.1-99.0%); two centres verified dose at isocenter with a maximum deviation of 9.6%, one plan was considered not acceptable.



Conclusions: This project showed differences in terms of the parameters considered with possible clinical implication.